

[54] 4-DESOXY-THIAZOLO[5,4-c]RIFAMYCIN
DERIVATIVES AND THEIR USE AS
ANTIMICROBIAL AGENTS

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[52] U.S. Cl. 424/270; 260/239.3 P

[58] Field of Search 260/239.3 P; 424/270

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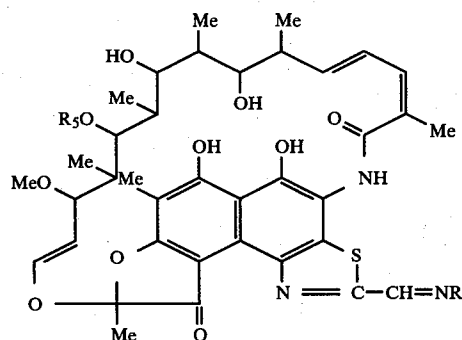
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Primary Examiner—John M. Ford

Assistant Examiner—Robert T. Bond

[57] ABSTRACT

Novel 4-desoxy-thiazolo[5,4-c]rifamycin derivatives of
formula I



wherein R stands for a group —OR₁, —NR₂R₃ or —NHCOR₄ wherein R₁ represents alkyl, alkenyl, alkynyl, cycloalkyl, aryl or aralkyl, R₂ and R₃ are independently selected from hydrogen, alkyl, alkenyl, alkynyl, cycloalkyl, aryl and aralkyl or R₂ and R₃ taken together with the adjacent nitrogen atom may represent a 5 to 7 membered heterocyclic ring and R₄ is a radical selected from the group consisting of alkyl, alkenyl, alkynyl, cycloalkyl, aryl and aralkyl; R₅ is hydrogen or acetyl; and a process for preparing them.

The novel compounds have an antibacterial utility.

7 Claims, No Drawings

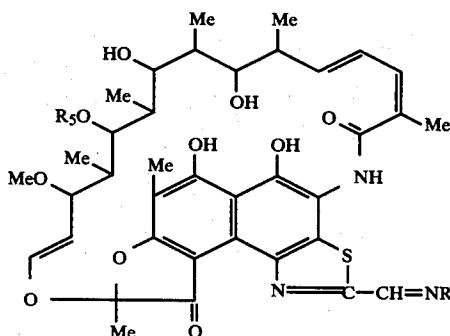
4-DESOXY-THIAZOLO[5,4-c]RIFAMYCIN DERIVATIVES AND THEIR USE AS ANTIMICROBIAL AGENTS

BACKGROUND OF THE INVENTION

In the prior art and more particularly in Belgium Patent Nos. 832921 and 855153 the class of compounds thiazolo[5,4-c]rifamycins are described which bear a hydrogen atom on the 2 bond-positioned carbon atom of the thiazole ring (i.e. rifamycin P). While the former patent describes the novel compound and a method for producing it by fermenting *Nocardia mediterranea* strains ATCC 31064, 31065 and 31066, the latter relates to a process for preparing rifamycin P and rifamycin Q, the corresponding 2'-hydroxymethyl derivative, by condensing rifamycin S with a cysteine ester and then decarboxylating or reducing the obtained intermediate. Moreover, some condensation products of rifamycin S with cysteine esters, amides or hydrazides, i.e. thiazolorifamycins characterized by a carbalkoxy, carbamyl or hydrazinocarbonyl group on the 2'-positioned carbon atom, are known from German Offenlegungsschrift No. 2720113.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention is concerned with 4-desoxy-thiazolo[5,4-c]rifamycin derivatives of the general formula I



wherein R stands for a group $-\text{OR}_1$, $-\text{NR}_2\text{R}_3$, or $-\text{NHCOR}_4$ wherein R_1 represents alkyl, alkenyl, alkynyl, cycloalkyl, aryl or aralkyl, R_2 and R_3 are independently selected from hydrogen, alkyl, alkenyl, alkynyl, cycloalkyl, aryl and aralkyl, or R_2 and R_3 taken together with the adjacent nitrogen atom may represent a 5 to 7 membered heterocyclic ring and R_4 is a radical selected from the group consisting of alkyl, alkenyl, alkynyl, cycloalkyl, aryl and aralkyl, R_5 is hydrogen or acetyl. As used herein, the term "alkyl" and the "alkyl" portion in the other hereinlisted substituents containing an aliphatic saturated moiety, identifies straight or branched radicals having from 1 to 8 carbon atoms, which can be unsubstituted or contain one or more substituents on the carbon chain such as halogen atoms, amino, mono- and di-(C_1 - C_4)alkylamino, (C_1 - C_4)alkoxy, (C_5 - C_8)cycloalkoxy, phenoxy, phenyl-(C_1 - C_4)alkoxy, nitro, cyano, hydroxy, carboxy, carbo(C_1 - C_4)alkoxy and carbamoyl.

The terms "alkenyl" and "alkynyl" refer to straight or branched radicals having at most 8 carbon atoms

which may contain one or a plurality of double and triple bonds respectively.

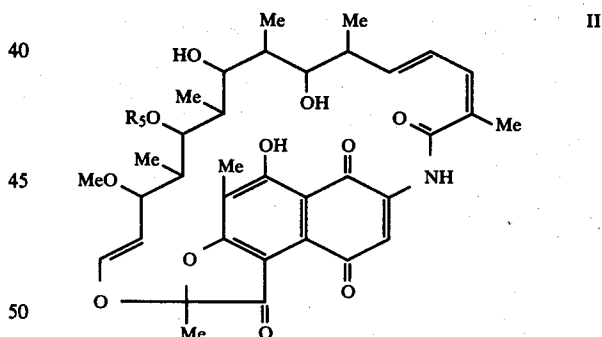
The expression "cycloalkyl" designates a cycloaliphatic ring containing from 5 to 8 carbon atoms which may optionally bear one or two (C_1 - C_4)alkyl substituents.

The term "aryl" and the "aryl" portion of the other hereinlisted substituents containing an aromatic moiety, identifies a benzene rest which can be unsubstituted or bear one or more substituents selected from halo, (C_1 - C_4)alkyl, halo-(C_1 - C_4)alkyl, (C_1 - C_4)alkenyl, (C_5 - C_8)cycloalkyl, amino, mono- and di-(C_1 - C_4)alkylamino, (C_1 - C_4)alkoxy, methylenedioxy, cyano, carboxy, hydroxy, carbo-(C_1 - C_4)alkoxy, carbamoyl and nitro.

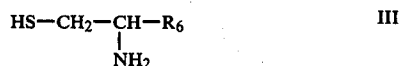
The expression "5 to 7 membered heterocyclic ring" includes also compounds having a further heteroatom selected from oxygen, nitrogen and sulfur and bearing (C_1 - C_4)alkyl or (C_4 - C_7)cycloalkyl substituents such as, for instance, pyrrolidine, pyrazolidine, piperidine, piperazine, 4-methyl-piperazine, 4-cyclopentylpiperazine, 4-cyclopropylpiperazine, morpholine and thiazolidine.

In the structure formulas "Me" identifies the methyl group.

The novel compounds of the present invention are prepared by a process which, starting from rifamycin S or its 25-desacetyl derivative of formula II



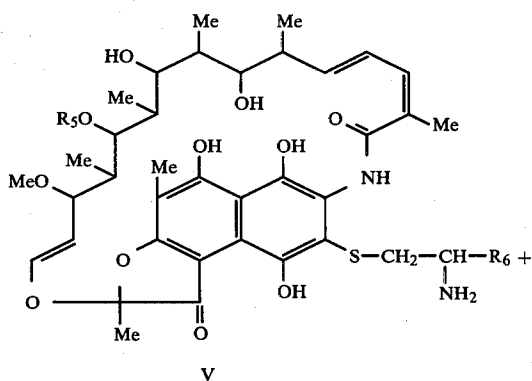
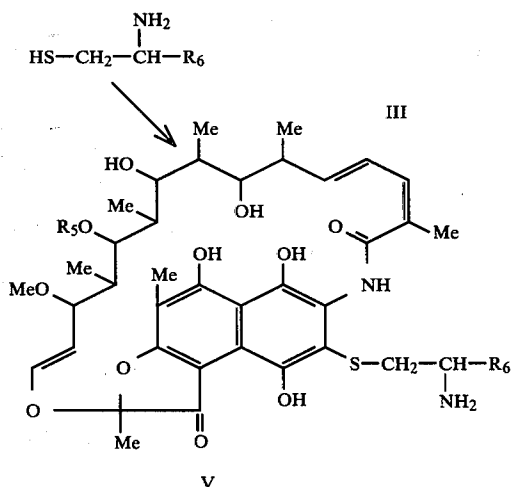
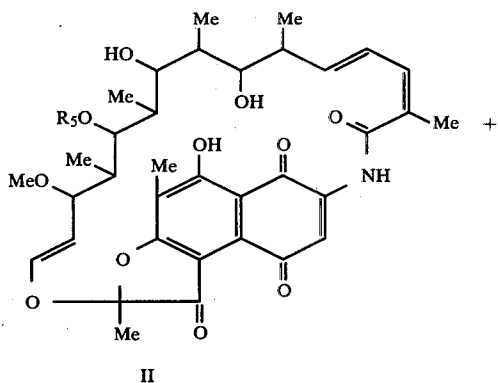
wherein R_5 is hydrogen or acetyl, a cysteine derivative of formula III



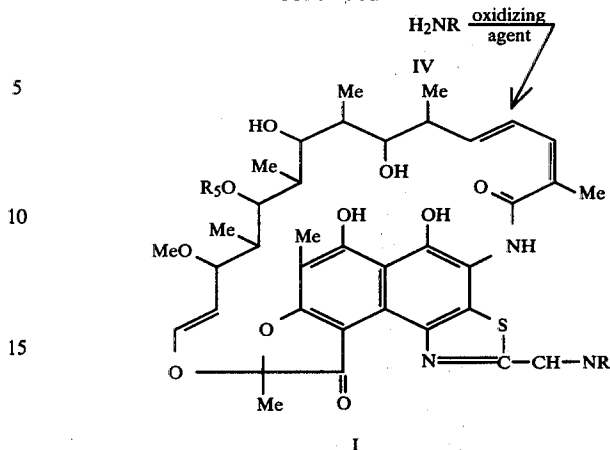
wherein R_6 stands for $-\text{H}$ or $-\text{COOH}$, and a compound of formula IV



wherein R is as defined before, runs through the following scheme:



-continued



The process of the invention which in the above scheme is represented according to a two-step procedure may as well be performed in a single step. According to the two-step procedure, about equimolecular amounts of reactants II and III are contacted in a water-miscible organic solvent such as a lower alkanol, dioxane, tetrahydrofuran or dimethylsulfoxide, yielding the open-chained intermediate V. The temperature of this first step of the reaction may range between room temperature and the boiling temperature of the reaction mixture and preferably between 18° and 45° C. The reaction time, which essentially depends on the temperature of the reaction, is generally determined by observing the disappearance of the starting rifamycin S by thin layer chromatography (t.l.c.)

Once this first step is completed, the thus obtained 3-[(2-aminoethyl)thio]rifamycin (V $R_6=H$) or 3-[(2-amino-2-carboxyethyl)thio]rifamycin (V $R_6=COOH$) is reacted at room temperature under stirring with a compound of formula IV in the presence of at least the stoichiometric amount of a suitable oxidizing agent. Suitable oxidizing agents, promoting the second reaction step can be selected from a wide group of substances such as quinones, organic nitrites, peroxides, persulfates, nitrous acid, tetravalent manganese and lead derivatives, trivalent iron derivatives, mercuric and cupric salts.

Among the preferred oxidizing agents are for instance p-quinone, 2,5-dimethyl-p-quinone, 2,6-dimethoxy-p-quinone, tetrachloro-p-quinone (chloranil), dichlorodicyano-p-quinone, duroquinone, rifamycin S, alkyl nitrites, hydrogen peroxide, alkali metal persulfates, alkali metal ferricyanides, cupric acetate, mercuric acetate and manganese dioxide. In some instances, depending on the selected organic solvent and the polarity of the radical R, it may be useful, in order to better solubilize the reagent RNH_2 , to carry out this second step of the reaction in a water/water miscible organic solvent system, adding water or an aqueous buffer whose pH may range from 2 to 6.5 to the selected organic solvent.

When the reaction, which is followed by t.l.c., is completed, the mixture is worked up in order to eliminate the oxidizing agent or its reaction products. The operative conditions obviously depend on the nature of the selected oxidizing agent. More particularly, when quinones are used as the oxidants, it may be useful to eliminate the resulting hydroquinone derivative by re-

oxidation to the original quinone and simultaneous extraction of this latter with a proper solvent. Once the reaction side-products have been eliminated, the thiazolorifamycin I may be easily recovered as a crystalline product by following usual techniques.

Alternatively the reaction outlined in the above scheme may be carried out in a single step by reacting about equimolar proportions of the starting compounds II, III and IV in a water-miscible organic solvent in the presence of at least the stoichiometric amount of a suitable oxidizing agent which does not unfavourably interfere with the reactants, such as for instance a tetrasubstituted quinone or rifamycin S itself. Also in this case the reaction course is followed by thin layer chromatography (eluting with CHCl_3 : MeOH 9:1) which shows the disappearance of the starting rifamycin S and the presence of a yellow fluorescent spot due to the novel thiazolorifamycin of formula I. Generally as for the recovery of the end products and same procedure used in the two-step process can be advantageously followed.

The compounds of the present invention have an antibacterial utility. More particularly they possess an outstanding biological activity against gram-positive and gram-negative strains as well as mycobacteria when used in an effective antimicrobial amount. An effective antimicrobial amount refers to that amount of the active compound which will inhibit or kill a microbe upon contact. Contacting the microbe may be in vitro as on a non-living substrate, or in vivo, as in the treatment of an infection in an animal. As for the in vitro activity, the hereinbelow reported table shows the minimal inhibitory concentrations (MIC), expressed as $\mu\text{g/ml}$, of some representative members of the compounds of the invention:

Strain	Compound of example No.			
	1	2	3	4
<i>Staph. aureus</i>	0.0008	0.00078	0.003	0.00078
<i>Staph. aureus</i> Tour	0.003	0.003	0.006	0.001
<i>Strept. haemolyticus</i>	0.006	0.01	0.01	0.006
<i>Strept. faecalis</i>	0.025	0.006	0.01	0.003
<i>Dipl. pneumoniae</i>	0.006	0.006	0.003	0.006
<i>Proteus vulgaris</i>	0.8	6.25	6.25	3.12
<i>Escherichia coli</i>	12.5	12.25	6.25	12.5
<i>Kleb. pneumoniae</i>	25	25	12.5	25
<i>Pseud. aeruginosa</i>	6.25	25	25	12.5
Myc. Tub. H ₃₇ R _v	0.30	0.60	0.62	0.31

The need of new antibiotics is practically unending, since the pathogenic microorganisms are capable of acquiring resistance to several families of widely employed antibiotics. This fact has been confirmed by many scientists in the microbiological field. See for instance Chem. Eng. News of Sept. 25, 1978, page 27, left column.

The rifamycin derivatives of the present invention also are effective in inhibiting at low concentration the growth of microorganisms which are resistant to other known antibiotics and possess an outstanding in vivo activity against experimental infection by *Staphylococcus aureus* both when administered per os and subcutaneously.

For instance, doses from about 0.3 to about 3 mg/Kg s.c. of compounds representative of the invention are effective against *Staphylococcus aureus* infections in mice.

The following examples illustrate the process of the invention and describe in detail some compounds of

general formula I without limiting the scope of the invention.

EXAMPLE 1

4-deoxy-2'-[[[(phenylmethoxy)imino]methyl]-thiazolo[5,4-c]-rifamycin

4.1 ml of triethylamine, 900 mg of cysteine hydrochloride and 1.6 g of benzylhydroxylamine hydrochloride are added to a solution of 7 g of rifamycin S in 300 ml of methanol. After two hours at room temperature, the reaction mixture is taken to dryness under vacuum and the residue is purified by column chromatography (silica-gel Merck 0.05-0.20 mm, elutant CHCl_3 : MeOH 98:2).

The fractions containing the pure compound are pooled and taken to dryness and the obtained compound is crystallized from ethyl acetate/petroleum ether. Yield 400 mg-M.p. 139°-140° C. (with decomposition).

Elemental analysis		C	H	N	S
calculated for $\text{C}_{46}\text{H}_{53}\text{N}_3\text{O}_{12}\text{S}$		63.36	6.13	4.82	3.68
found		63.48	6.45	4.96	3.55
U.V. - visible absorption bands		(buffer pH 7.38)			
λ max (nm)	$E_1 \text{ cm}^{-1}\%$				
300	299				
400	204				

EXAMPLE 2

4-deoxy-2'-[[[(piperidinyl)imino]methyl]thiazolo[5,4-c]-rifamycin

1 g of cysteine and 1 ml of N-aminopiperidine are added at room temperature under stirring to a solution of 7 g of rifamycin S in 300 ml of methanol and 20 ml of buffer pH 4.6 (aqueous solution of citric acid and disodium phosphate). After 1 hour the reaction mixture is diluted with water, acidified and extracted with ethyl acetate. The organic phase is washed with a buffer solution to remove rifamycin SV, then obtained is purified by preparative chromatography, giving 1 g of pure compound M.p. 238°-40° C.

Elemental analysis		C	H	N	S
calculated for $\text{C}_{44}\text{H}_{56}\text{N}_4\text{O}_{11}\text{S}$		62.24	6.65	6.60	3.77
found		60.55	6.54	6.22	3.52
U.V. - visible absorption bands		(buffer pH 7.38)			
λ max (nm)	$E_1 \text{ cm}^{-1}\%$				
226	488				
276	288				
320	275				
405	276				

EXAMPLE 3

4-deoxy-2'-[[[(4-methyl-piperazinyl)imino]methyl]-thiazolo[5,4-c]-rifamycin

The compound of the title is prepared according to the procedure of the foregoing example but using N-amino-N'-methylpiperazine (1.6 ml) instead of N-aminopiperidine. Yield 450 mg. M.p. 180° C. (with decomposition).

Elemental analysis		C	H	N	S
calculated for $\text{C}_{44}\text{H}_{57}\text{N}_5\text{O}_{11}\text{S}$		61.16	6.65	8.11	3.71
found		59.78	6.54	7.88	3.52

-continued

U.V. - visible absorption bands		(buffer pH 7.38)
λ max (nm)	E_1 cm ¹ %	
279	334	
304	328	
398	283	

EXAMPLE 3 BIS

4-deoxy-2'-[[[(4-methyl-piperazinyl)imino]methyl]-thiazolo[5,4-c]rifamycin is also prepared according to a two-step procedure by adding 350 mg of manganese dioxide and 0.8 ml of N-amino-N'-methylpiperazine to a solution of 350 mg of 3-[(2-aminoethyl)thio]rifamycin in 15 ml of methanol and 1 ml of buffer pH 4.6, or by reacting a solution of 3-[(2-amino-carboxyethyl)thio]rifamycin in methanol and buffer pH 4.6 with N-amino-N'-methylpiperazine in the presence of an equimolar amount of rifamycin S as the oxidizing agent.

The open-chained starting compounds can be easily prepared by reacting equimolar amounts of rifamycin S and cysteine or cysteamine in a water-miscible organic solvent.

EXAMPLE 4

4-deoxy-2'-[[[(N,N-dimethyl)hydrazono]methyl]-thiazolo[5,4-c]rifamycin

The compound of the title is prepared according to the procedure described in example 2 but using N,N-dimethylhydrazine (60 mg) instead of N-aminopiperidine. Yield 650 mg M.p. > 172° C. (with decomposition).

Elemental analysis		C	H	N	S
calculated for C ₄₁ H ₅₂ N ₄ O ₁₁ S		60.87	6.48	6.93	3.96
found		59.76	6.35	6.78	3.87
U.V. - visible absorption bands		(buffer pH 7.38)			
λ max (nm)	E_1 cm ¹ %				
225	540				
265	328				
322	303				
394	288				

EXAMPLE 4 BIS

4-deoxy-2'-[[[(N,N-dimethyl)hydrazono]methyl]-thiazolo-[5,4-c]rifamycin is also prepared by reacting a dimethylsulfoxide solution of 3-[(2-aminoethyl)thio]rifamycin with an aqueous solution of Potassium ferri-cyanide and dimethylhydrazine for about 15 minutes.

EXAMPLE 5

4-deoxy-2'-[(acetylhydrazono)methyl]thiazolo[5,4-c]-rifamycin

800 mg of cysteine and 800 mg of acetohydrazide are added at room temperature, under stirring to a solution of 7 g of rifamycin S in 300 ml of methanol. After 4 hours, thin layer chromatography of the reaction mixture shows the disappearance of the starting rifamycin S, the presence of the yellow spot of the new product, the presence of rifamycin SV, besides trace-amount of by-products; the reaction mixture is taken to dryness under vacuum, dissolved in ethyl acetate and washed with buffer (pH 7.38); the buffered phase is acidified and extracted with ethyl acetate and the combined organic extracts are taken to dryness and further purified by

column chromatography yielding 1 g of pure compound. M.p. 185°-7° C. (with decomposition).

Elemental analysis		C	H	N	S
calculated for C ₄₁ H ₅₀ N ₄ O ₁₂ S		59.84	6.12	6.81	3.90
found		58.66	6.17	6.52	3.60
U.V. - visible absorption bands		(buffer pH 7.38)			
λ max (nm)	E_1 cm ¹ %				
225	581				
295	381				
408	286				

By operating according to the procedure of the foregoing examples, the following compounds are obtained:

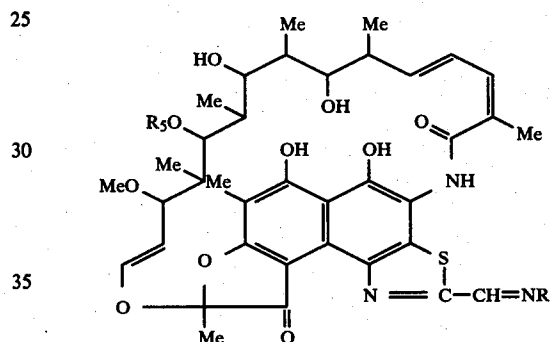
- 4-deoxy-2'-[[[(methoxy)imino]methyl]thiazolo[5,4-c]-rifamycin
- 4-deoxy-2'-[[[(ethoxy)imino]methyl]thiazolo[5,4-c]-rifamycin
- 4-deoxy-2'-[[[(propyloxy)imino]methyl]thiazolo[5,4-c]-rifamycin
- 4-deoxy-2'-[[[(butyloxy)imino]methyl]thiazolo[5,4-c]-rifamycin
- 4-deoxy-2'-[[[(pentyloxy)imino]methyl]thiazolo[5,4-c]-rifamycin
- 4-deoxy-2'-[[[(2-hydroxy-ethoxy)imino]methyl]-thiazolo-[5,4-c]rifamycin
- 4-deoxy-2'-[[[(octyloxy)imino]methyl]thiazolo[5,4-c]-rifamycin
- 4-deoxy-2'-[[[(1-carboxy-2-methyl-propyloxy)imino]-methyl]-thiazolo[5,4-c]rifamycin
- 4-deoxy-2'-[[[(2-phenylethoxy)imino]methyl]thiazolo-[5,4-c]rifamycin
- 4-deoxy-2'-[[[(3-phenyl-propyloxy)imino]methyl]-thiazolo-[5,4-c]rifamycin
- 4-deoxy-2'-[[[(2,4-dichlorophenyl)methoxy]imino]-methyl]-thiazolo[5,4-c]rifamycin
- 4-deoxy-2'-[[[(1-propyl-butoxy)imino]methyl]-thiazolo-[5,4-c]rifamycin
- 4-deoxy-2'-[[[(4-pentenloxy)imino]methyl]thiazolo-[5,4-c]rifamycin
- 4-deoxy-2'-[[[(2-ethylpropenyloxy)imino]methyl]-thiazolo-[5,4-c]rifamycin
- 4-deoxy-2'-[[[(2-propenyloxy)imino]methyl]-thiazolo[5,4-c]-rifamycin
- 4-deoxy-2'-[[[(2-propynyloxy)imino]methyl]-thiazolo[5,4-c]-rifamycin
- 4-deoxy-2'-[[[(2-phenoxy-ethoxy)imino]methyl]-thiazolo-[5,4-c]rifamycin
- 4-deoxy-2'-[[[(1-ethylpentyloxy)imino]methyl]-thiazolo-[5,4-c]rifamycin
- 4-deoxy-2'-[[[(tricyclopentylmethoxy)imino]methyl]-thiazolo-[5,4-c]rifamycin
- 4-deoxy-2'-[[[(cyclopentyloxy)imino]methyl]thiazolo-[5,4-c]rifamycin
- 4-deoxy-2'-[[[(2-propyloxy-ethoxy)imino]methyl]-thiazolo-[5,4-c]rifamycin
- 4-deoxy-2'-[[[(2-dimethylamino)ethoxy]imino]methyl]thiazolo-[5,4-c]rifamycin
- 4-deoxy-2'-[[[(2-diethylamino)ethoxy]imino]methyl]-thiazolo[5,4-c]rifamycin
- 4-deoxy-2'-[[[(2-methylamino)ethoxy]imino]methyl]-thiazolo[5,4-c]rifamycin
- 4-deoxy-2'-[[[(cycloheptyloxy)imino]methyl]thiazolo-[5,4-c]rifamycin
- 4-deoxy-2'-[[[(1-piperazinyl)imino]methyl]thiazolo-[5,4-c]rifamycin

4-deoxy-2'-[[[(4-morpholinyl)imino]methyl]thiazolo-
[5,4-c]rifamycin
4-deoxy-2'-[[[(1-pyrrolidinyl)imino]methyl]thiazolo-
[5,4-c]rifamycin
4-deoxy-2'-[[[(4-cyclopentyl-1-piperazinyl)imino]me-
thyl]thiazolo[5,4-c]rifamycin
25-desacetyl-4-deoxy-2'-[[[(phenylmethoxy)imino]me-
thyl]thiazolo[5,4-c]rifamycin
25-desacetyl-4-deoxy-2'-[[[(methoxy)imino]methyl]-
thiazolo[5,4-c]rifamycin
25-desacetyl-4-deoxy-2'-[[[(4-pentenyl)oxy]imino]me-
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imino)-methyl]thiazolo[5,4-c]rifamycin
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piperazinyl)-imino]methyl]thiazolo[5,4-c]rifamycin
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thiazolo[5,4-c]rifamycin
4-deoxy-2'-[[[(3-methyl-phenyl)hydrazono]methyl]-
thiazolo[5,4-c]rifamycin
4-deoxy-2'-[[[(2,4-dinitrophenyl)hydrazono]methyl]-
thiazolo[5,4-c]rifamycin
4-deoxy-2'-[[[(2-propenyl)hydrazono]methyl]-
thiazolo[5,4-c]rifamycin
4-deoxy-2'-[[[(2-phenoxyethyl)hydrazono]methyl]-
thiazolo[5,4-c]rifamycin
4-deoxy-2'-[[[(N,N-di(2-diethylaminoethyl)hy-
drazono]methyl]thiazolo[5,4-c]rifamycin
4-deoxy-2'-[[[(2-(4-amino-2,6-dichlorophenoxy)ethyl)-
hydrazono]methyl]thiazolo[5,4-c]rifamycin
4-deoxy-2'-[[[(2-methylphenyl)hydrazono]methyl]-
thiazolo[5,4-c]rifamycin
4-deoxy-2'-[[[(4-fluorophenyl)hydrazono]methyl]-
thiazolo[5,4-c]rifamycin
4-deoxy-2'-[[[(N-butyl-N-methyl)hydrazono]methyl]-
thiazolo[5,4-c]rifamycin
4-deoxy-2'-[[[(4-(α,α -dimethylethyl)-2,6-dimethyl-
phenyl)hydrazono]methyl]thiazolo[5,4-c]rifamycin
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thiazolo[5,4-c]rifamycin
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thiazolo[5,4-c]rifamycin
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[5,4-c]rifamycin
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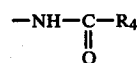
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4-deoxy-2'-[[[(2-methoxy-benzoyl)hydrazono]me-
thyl]thiazolo[5,4-c]rifamycin
25-desacetyl-4-deoxy-2'-[[[(cyclopentyl)hydrazono]-
methyl]thiazolo[5,4-c]rifamycin
25-desacetyl-4-deoxy-2'-[[[(cyclohexyl)hydrazono]-
methyl]thiazolo[5,4-c]rifamycin
25-desacetyl-4-deoxy-2'-[[[(butyl)hydrazono]methyl]-
thiazolo[5,4-c]rifamycin

We claim:

1. A 4-desoxy-thiazolo[5,4-c]-rifamycin of the formula



wherein R stands for a group $-\text{OR}_1$, $-\text{NR}_2\text{R}_3$ or



wherein R_1 represents alkyl having 1 to 8 carbon atoms per group and no substitution or halo, amino, mono- or di- (C_{1-4}) alkylamino, C_{1-4} alkoxy, C_{5-8} cycloalkoxy, phenoxy phenyl (C_{1-4}) alkoxy, nitro, cyano, hydroxy, carboxy, carbo (C_{1-4}) alkoxy or carbamoyl substitution; alkenyl having up to 8 carbon atoms per group which contains one or two double bonds, alkynyl having up to 8 carbon atoms per group which contains one or two triple bonds, cycloalkyl having a cycloaliphatic ring containing from 5 to 8 carbon atoms and having up to two C_{1-4} alkyl substituents, aryl or aralkyl wherein aryl as such or in a compound term designates phenyl or phenyl having halo, C_{1-4} alkyl, halo (C_{1-4}) alkyl, C_{1-4} alkenyl, C_{5-8} cycloalkyl, amino, mono- or di- (C_{1-4}) alkylamino, C_{1-4} alkoxy, methylenedioxy, cyano, carboxy, hydroxy, carbo (C_{1-4}) alkoxy, carbamoyl or nitro substitution,

R_2 and R_3 are independently selected from hydrogen, alkyl, alkenyl, alkynyl, cycloalkyl, aryl and aralkyl, as defined above, or R_2 and R_3 taken together with the adjacent nitrogen atom may form a 5-7 membered heterocyclic ring wherein the hetero atoms are nitrogen, and

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R₄ is a radical selected from the group consisting of alkyl, alkenyl, alkynyl, cycloalkyl, aryl and aralkyl, as defined above and; R₅ is hydrogen or acetyl.

2. A compound as claimed in claim 1 and being the 4-deoxy-2'-[[[(phenylmethoxy)imino]methyl]-thiazolo[5,4-c]rifamycin.

3. A compound as claimed in claim 1 and being the 4-deoxy-2'-[[[(piperidinyl)imino]methyl]thiazolo[5,4-c]rifamycin.

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4. A compound as claimed in claim 1 and being the 4-deoxy-2'-[[[(4-methyl-piperazinyl)imino]methyl]-thiazolo[5,4-c]rifamycin.

5. A compound as claimed in claim 1 and being the 4-deoxy-2'-[[[(N,N-dimethyl)hydrazono]methyl]-thiazolo[5,4-c]rifamycin.

6. A compound as claimed in claim 1 and being the 4-deoxy-2'-[(acetylhydrazono)methyl]thiazolo[5,4-c]rifamycin.

7. Method which comprises contacting a susceptible microbe with an effective antimicrobial amount of a compound as claimed in claim 1.

* * * * *

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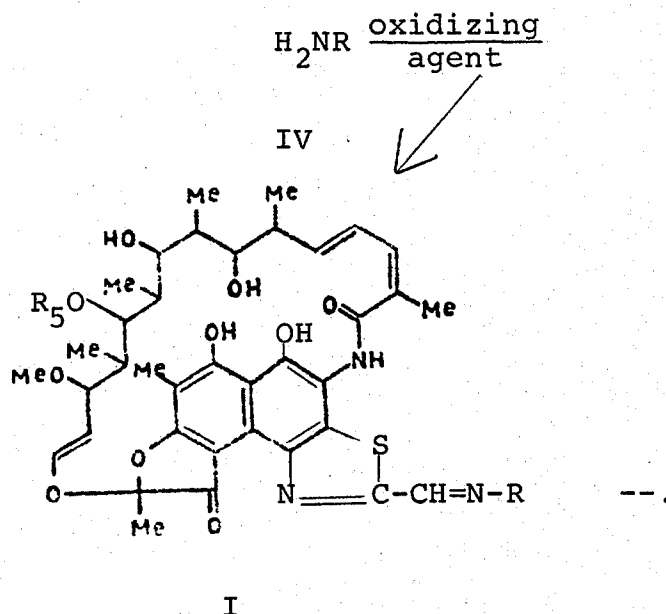
UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 4,212,873
 DATED : July 15, 1980
 INVENTOR(S) : Renato Cricchio, et al.

Page 1 of 2

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, lines 5-15, the formula should read:



Column 5, line 19, "products and same" should read --products the same--.

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 4,212,873

Page 2 of 2

DATED : July 15, 1980

INVENTOR(S) : Renato Cricchio, et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 6, line 41, "then obtained" should read,
--then anidrified and taken to dryness. The crude
material thus obtained--.

Column 9, line 65, should read -- 4-deoxy-2'-[[(3-
-phenylpropanoyl)hydrazono]methyl]- --.

Signed and Sealed this

Twenty-fifth Day of November 1980

[SEAL]

Attest:

SIDNEY A. DIAMOND

Attesting Officer

Commissioner of Patents and Trademarks